University of Saskatchewan

Department of Computer Science

CMPT: 394

Midterm Exam   (75 Marks)   Feb. 28, 2002

No outside materials are allowed. Be sure to allocate your time to your best advantage.

This exam is based on the following case study:

SuperService is a new store chain that focuses on providing good service to its customers. SuperService is planning to build a new store in Saskatoon and wants to determine the staff it needs to hire to meet with its expected level of customers. To ensure that it gets good results it wants you to run your simulation 100 times. It plans to be open from 9:00 am to 9 pm daily. Store staff will actually stay after closing (for up to an extra hour if necessary) to handle customers who have arrived before closing time.

Types of employees.
clerk clerk
sales
manage-
manager clerk
sales

There are three types of employees at a typical SuperService store: managers, sales associates, and clerks. Sales associates act as sales consultants and clerks act as cashiers. Managers are active workers and will act as sales consultants or cashiers if they are not needed to deal with customers in their role as managers. Initially it is expected that there will be at least one manager, two sales consultants, and one cashier available for customers at all times. (The store will be designed to handle more staff of all types if they are needed to provide good service.)

Arrival rate schedule

SuperService expects customers will arrive on average: one customer per minute from 9:00 am to 3 pm, two customers per minute between 3 pm and 7 pm, and one customer every two minutes from 7pm till closing. These customers will have come with one of three types of intentions.

A. 20% of all customers are coming to buy something specific. They will spend between 1 and 5 minutes shopping on their own. After shopping on their own, 25% of these customers will have trouble finding what they want and require the assistance of a sales consultant or manager for between 1 and 5 minutes (with an average of 2.5 minutes). It is expected that 80% of the shoppers who have come to buy something specific will actually make a purchase.

B. 60% of all customers are coming **to shop** and if they find what they want will be willing to buy it. 30% of these shoppers will want to have a sales consultant help them throughout their shopping. The actual time for these customers to shop (with or without a sales consultant) will be between 2 and 15 minutes with an average of 6 minutes. Once they have completed their shopping, 50% of these customers will make a purchase, 25% will want to speak to a manager, and the rest will just leave without purchasing anything. Talking to a manager will take between 2 and 8 additional minutes with an average of 5 minutes. 30% of the customers who talk to a manager will decide to make a purchase and the rest will leave without purchasing anything.

C. 20% of customers have just come **to browse**. They will typically take between 5 and 15 minutes looking at items in the store. 80% will leave without buying anything or asking for any help, 10% will buy something and 10% will want to have a sales consultant help them once they are finished browsing. If a sales consultant is available immediately they will take between 4 and 16 minutes more with an average of 6 minutes, otherwise they will just leave without buying anything. 30% of the browsers who do talk to a sales consultant will purchase something.

Once customers have finished all their shopping they will go to a cashier where they will spend between 1 and 5 minutes (with an average of 2 minutes) paying for their purchases. Once they are done, they will depart.

You are to analyze the case study and then design a suitable Arena simulation **using only modules from the basic process and/or advanced process panel** to create a simulation for SuperService. (Do not use any blocks from the blocks panel.) Don't forget to also specify the run setup - you should treat it as an additional module.

Answer this question with both a diagram of the ARENA flowchart modules you would use to solve the problem and a set of description each ARENA module. Make sure that you list all the data that would be used, including data that might be defaulted in Arena, so that you identify all the required items.

Make sure that each of your modules has both:
- a name that clearly describes what it is simulating from the problem
- what type of ARENA module it is

1. ARENA flowchart (25 marks for an easy to follow diagram that identifies and names the flowchart modules needed to simulate the system and for correctly showing the flow between the modules):
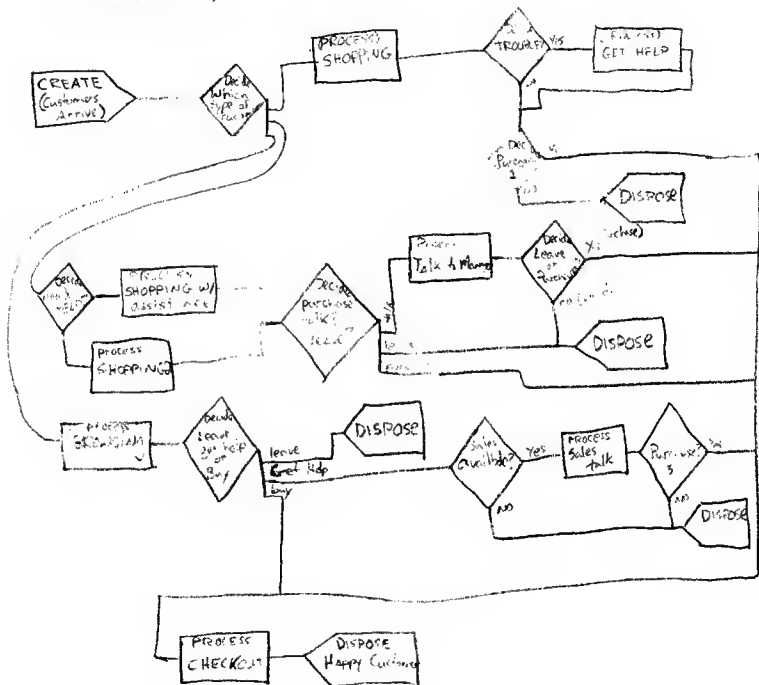
2. Descriptions of each flowchart or spreadsheet module and for a description of the run setup (50 marks for details of the modules):

Run/Setup

In the run/setup is project parameters; I would put the following data

    # of replications : 100 times
    replication length : ~~12.5~~ 13   units: Hours
    length of day : 12.5
    Base Time Units : minutes.
    warm-up period : 0.0   units: minutes.

- I put the replication length to 12 for the hours between 9am - 9pm and an additional half hour (.5) for the customers to exit the store.
     problem said up to an <u>hour</u>

Create (customers Arrive) module

    name: Customers Arrive
    entity type: Customer
    Value : 1
    Type: Based on ~~the~~ schedule   Schedule name : Customer Arrival schedule.
    ~~Costs~~
    # of Arrivals:= Infinite
    start of arrivals   0.0.

Customer Arrival Schedule   spreadsheet

    name : customer arrival schedule
    units : half hours
        hit ⟮0 rows⟯ → fill out graph like this.

Arrival Rate

~~~~ in ⟮Options⟯   set :
         y-axis max: 60
             min : 0
             space snaping : 1

                       hit ⟮OK⟯
         ☑ do not repeat

Resources ?
Sets

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Descriptions continued:

Shipping w/ assistance   Process
name shipping w/ assistance
type : Standard
action : Seize, Delay Release
           Seize : Set of workers   preferred order

Delay type : Expression
Expression : @ TRIA[2, 6, 15]
Units : minutes

---

shipping 2   (Process)
name : Shipping 2
type : Standard
action : ~~seize~~ Delay ~~Release~~
Delay type : Expression
Expression : TRIA[2, 6, 15]
Units : minutes.

                          Decide
~~⊗~~ name : Purchase? talk? leave?
type : n-way by chance
         assignments [add] → 25
                      [add] → 25
                      [add] → 50

Process name : Talk to Manager
type : Standard
action : Seize, delay, Release
          Seize - ~~set of workers~~ Manager
Delay type : Expression
Expression : TRIA[2, 5, 8]
Units : minutes

Decide name : Leave or Purchase?
type : 2 way by chance
true percent : 30